WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a contact plug formed within an interlayer dielectric film provided on a semiconductor region, and is electrically connected to the semiconductor region;

a first oxygen barrier layer formed on the interlayer dielectric film to be in contact with the contact plug, the first oxygen barrier layer has a conducting property and prevents the diffusion of oxygen;

a second oxygen barrier layer formed in contact with the side surfaces of the first oxygen barrier layer, the second oxygen barrier layer has an insulating property and prevents the diffusion of oxygen;

a lower electrode formed in contact with the top surface of the first oxygen barrier layer;

a capacitive insulating film formed in contact with the lower electrode; and

an upper electrode formed in contact with the capacitive insulating film.

2. The device of claim 1, wherein the first oxygen barrier layer includes a lower layer and an upper layer, the lower layer contains a conductive nitride and is in contact with the contact plug, and the upper layer contains a conductive oxide and is formed on the lower layer.

3. The device of claim 2, wherein the conductive nitride includes at least one material selected from a group consisting titanium nitride, titanium aluminum nitride, titanium silicon nitride, tantalum nitride, tantalum aluminum nitride and tantalum silicon nitride.

4. The device of claim 2, wherein the second oxygen barrier layer is in contact with the side surfaces of the lower layer.

5. The device of claim 1, wherein the thickness of the second oxygen barrier layer is between 5nm and 50nm inclusively.

6. The device of claim 1, wherein the second oxygen barrier layer is composed of an oxide.

7. The device of claim 1, wherein the second oxygen barrier layer contains aluminum oxide.

8. The device of claim 1, wherein the second oxygen barrier layer contains at least one of aluminum oxide, titanium aluminum oxide and tantalum aluminum oxide.

9. The device of claim 1, wherein the distance between each side surface of the contact plug and the second oxygen barrier layer is between 0nm and 100nm inclusively.

10. The device of claim 1, wherein the capacitive insulating film includes at least one material selected from a group consisting $SrBi_2(Ta_xNb_{1-x})_2O_9$, $Pb(Zr_yTi_{1-y})O_3$, $(Ba_zSr_{1-z})TiO_3$, $(Bi_uLa_{1-u})_4Ti_3O_{12}$ (where $0 \leqq x \leqq 1$, $0 \leqq y \leqq 1$, $0 \leqq z \leqq 1$, $0 \leqq u \leqq 1$) and Ta_2O_5.

11. A method for fabricating a semiconductor device comprising the steps of:

(a) forming an interlayer dielectric film on a semiconductor region;

(b) selectively forming a contact plug within the interlayer dielectric film to be in contact with the semiconductor region;

(c) forming a first oxygen barrier layer on the interlayer dielectric film to be in contact with the contact plug, the first oxygen barrier layer has a conducting property and

prevents the diffusion of oxygen;

(d) forming a second oxygen barrier layer on the side surfaces of the first oxygen barrier layer, the second oxygen barrier layer has an insulating property and prevents the diffusion of oxygen;

(e) forming a lower electrode to be in contact with the top surface of the first oxygen barrier layer;

(f) forming a capacitive insulating film over the lower electrode such that the lower electrode is being covered;

(g) forming an upper electrode over the capacitive insulating film such that the capacitive insulating film is being covered; and

(h) performing a heat treatment on the capacitive insulating film in an oxygen ambient.

12. The method of claim 11, wherein the step (c) further includes a step of forming a lower layer containing a conductive nitride in contact with the contact plug, and

a step of forming an upper layer containing a conductive oxide in contact with the lower layer.

13. The method of claim 11, wherein in step (h), the temperature of the heat treatment is between 500℃ and 850℃ inclusively.

14. The method of claim 11, wherein the step (d) further includes a step of forming an oxygen-barrier-formation layer over the entire interlayer dielectric film including the first oxygen barrier layer, and

a step of performing an etchback process by anisotropic etching the oxygen-barrier-formation layer, thereby forming a second oxygen barrier layer from the oxygen-barrier-formation layer on the side surfaces of the first oxygen barrier layer.